Combining Usability Testing with Eye-Tracking Technology: Evaluation of a Visualization Support for Antibiotic Use in Intensive Care

Aboozar Eghdam – August 30th 2011 Oslo

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Background

• Intensive care
• Antibiotic use
• Usability of software used in such an environment is critical
• Usability testing
• Eye-tracking technology
Aim and objectives

• Exploratory usability investigation and an initial performance testing of *Infobiotika*

  – To investigate if *Infobiotika* supports efficient and effective navigation
  – To observe users’ navigation paths, visual scan patterns and distribution of visual attention
  – To explore if users find the information needed to support antibiotic treatment in intensive care
  – To measure the learnability of *Infobiotika*
  – To obtain participants’ thoughts and feelings

Electronic patient record system

*Infobiotika*

Bacteriological laboratory system

Radiology information system
Methods (1/2)

• Usability testing + eye-tracking

ISO 9241-11: The extent to which a product can be used by specified users to achieve specified goals with effectiveness (Task completion by users), efficiency (Task in time) and satisfaction (responded by user in term of experience) in a specified context of use (users, tasks, equipments & environments)

• Two user groups: Specialists & Residents

• A mixed method design
  • Between-subjects design
    • for type of users with two levels of experience (specialists and residents)
  • Within-subjects design
    • for tasks, where all the participants were going to be tested under the same conditions

• Test environment
**Methods (2/2)**

- **Procedure**
  - Pre-test arrangements
  - Introduction to the study and prototype
  - Task performance
    - *Navigational Tasks (15 randomized tasks)*
      - Performance time
      - Navigation paths
      - Accuracy of responses.
    - *Clinical Tasks (8)*
      - Structured on the basis of an example dialogue with an infection disease consultant
      - Think-aloud
      - No time pressure
    - *Free exploring time 3-5 min*
    - *Learnability Tasks (6)*
      - Slightly modified to avoid the possibility of memorizing previous answers
  - A debriefing session (SUS)
  - The eye-tracking equipment was applied the entire test
Results (1/2)

- **Table 1.** Number and type of participants in Infobiotika usability evaluation study

<table>
<thead>
<tr>
<th></th>
<th>Study participants (Danderyd Hospital)</th>
<th>Study participants (S:t GöransHospital)</th>
<th>Pilot-test participants (Karolinska Hospital)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialists</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Residents</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Usability experts</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

- **Navigation**
  - Tables -> graphs
  - Residents -> graphs
  - Specialists -> tables

- **Clinical tasks**
  - Participants score
  - Fulfilled most of their expectations
  - Positive impression
Results (2/2)

• Learnability Tasks
  – Positive learning effect

• Eye-tracking data
  – Specialists stayed more focused
  – Residents were exploring the user interface
  – Increasing use of charts and graphs

• SUS questionnaire result = 79.5%
  – Acceptable system
Discussion

• Infobiotika: A potentially valuable aid in supporting faster decision-making

• The use of eye-tracking
  – Analyzing and understanding users’ action
  – Detect differences between specialists’ and residents’ performances

• Limitations
  – Not the real clinical setting
  – Number of participants
  – Testing time
Conclusion

• Eye-tracking
  – A valuable complement to traditional usability methods
    • Navigation
    • User behavior

• Confirmation is needed!
• User centered design in development phase
• Usability testing before deployment
• More practice and training for senior users
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THANK YOU FOR YOUR ATTENTION!
Time Spent performing a task

Time For Task NC

- Time For Specialists
  Task NC
  N=4

- Time For Residents
  Task NC
  N=4
Effectiveness for a task

Effectiveness for Navigational task NB

Specialists

- Succeeded: 2
- Failed: 2

Residents

- Succeeded: 3
- Failed: 1
Number of mouse clicks for a task

Number of clicks
Task NB

Number of clicks
For Specialists
Task NB
N=2

Number of clicks
For Residents
Task NB
N=3
Heat map: Participants’ performances using Overview - Navigational task NM, N=3

Heat map: Participants’ performances using Overview - Learnability task LB, N=1
Participants activates diagrams for Learnability task LA

Effectiveness for Learnability Task LA compare to Navigational Task NE

Participants’ Used views for
Learnability Task LA

- Failed Participants
- Succeeded Participants

Number of participants who used the same view as they did when performing the Navigational task successfully
Number of participants who didn’t use the same view as they did when performing the Navigational task

Time comparison for Participants who successfully performed Learnability Task LA and used the same view as they did when performing Navigational Task NE successfully

Time comparison for Participants who successfully performed Learnability Task LA and didn’t use the same view as they did when performing Navigational Task NE
Time spent using Overview

Overall time spent using "Overview"

- Specialists: N=4
  - Average: [Value]
  - Range: [Value]

- Residents: N=4
  - Average: [Value]
  - Range: [Value]

Individual time spent using "Overview"

- Specialist 1: [Value] seconds
- Specialist 2: [Value] seconds
- Specialist 3: [Value] seconds
- Specialist 4: [Value] seconds
- Resident 1: [Value] seconds
- Resident 2: [Value] seconds
- Resident 3: [Value] seconds
- Resident 4: [Value] seconds

All participants time spent using “Overview”

Individual participants’ time spent using “Overview”

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## Participants impressions about Infobiotika

<table>
<thead>
<tr>
<th>Participants</th>
<th>Clear overview of the patient information</th>
<th>Supporting treatment</th>
<th>Any advantages by having Infobiotika</th>
<th>Infobiotika or current system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialist 01</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Specialist 02</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Specialist 03</td>
<td>Somehow</td>
<td>Somehow</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Specialist 04</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Resident 01</td>
<td>Yes</td>
<td>Yes, perhaps, not a whole undoubtedly yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Resident 02</td>
<td>Yes</td>
<td>Yes, definitely</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Resident 03</td>
<td>Somehow</td>
<td>Yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
<tr>
<td>Resident 04</td>
<td>Somehow</td>
<td>Yes</td>
<td>Yes</td>
<td>Infobiotika</td>
</tr>
</tbody>
</table>
SUS

Individual participants rate

<table>
<thead>
<tr>
<th>Specialist 1</th>
<th>Specialist 2</th>
<th>Specialist 3</th>
<th>Specialist 4</th>
<th>Resident 1</th>
<th>Resident 2</th>
<th>Resident 3</th>
<th>Resident 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>88%</td>
<td>80%</td>
<td>90%</td>
<td>83%</td>
<td>75%</td>
<td>90%</td>
<td>80%</td>
<td>53%</td>
</tr>
</tbody>
</table>

SUS Score

Acceptability Ranges

Grade Scale

Adjective Ratings

Worst Imaginable | Poor | OK | Good | Excellent | Best Imaginable

0 10 20 30 40 50 60 70 80 90 100
Heat maps - Overview

Heat map: Specialists performances using Overview, N=3

Heat map: Residents’ performances using Overview, N=4